IPRO 362: M.O.R.E. Life

Designing mobile operating rooms to aid in natural disasters

ILLINOIS INSTITUTE OF TECHNOLOGY

Problem Statement:

"…the earth is currently experiencing approximately 500 natural disasters per year."
–Natural News

Globally, there are a large number of individuals affected by natural disasters each year. Obstacles such as the destruction of medical facilities and road infrastructure prevent aid from reaching the affected locations. To combat this, typically makeshift medical tents are set up by relief workers and the results are often overcrowding, lack of sanitary conditions, and the spread of infection. In fact, it is this spread of infection, and not the disaster itself that accounts for post disaster deaths/victims.

Current Solutions:

54 ft. long Operating Room on Wheels

Deployable Rapid Assembly Shelter

Current mobile operating rooms have a few major limitations that make them inefficient and call for a need in improved technology. The high cost of set-up, inconvenient deployment methods, dependence upon limited energy resources, and, above all, the lack of a filtration system to provide a sterile environment for treatment all demonstrate the inefficiencies current solutions provide.

These technologies require road infrastructure for their transportation, which make them inadequate for disaster situations. Their dependence on fossil fuels increase not only their cost but make their set-up logistics more cumbersome. The unsterile environment poses a problem for victims in immediate need of surgery because of the risks of contracting infections.

Objective:

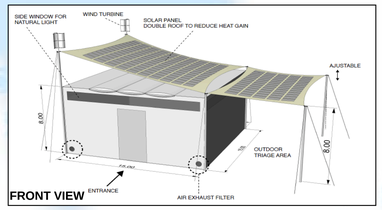
The objective of the M.O.R.E. Life project is to address five main challenges:

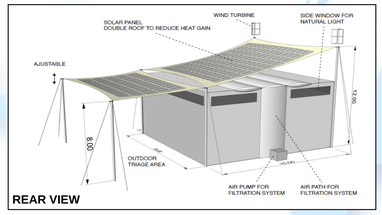
- Sterility & Filtration
- Power Source
- Modularity & Portability
- Cost Effectiveness
- Community Involvement

HAITI 2010
Unsanitary medical conditions
Underdeveloped country
Overwhelming need for help in remote areas

KATRINA 2004
Widespread of bacterial diseases
Insufficient medical facilities
Extreme Overcrowding

Results:





Power:

Solar panels and wind turbines will primarily power the structure's filtration system, medical equipment, and lighting system as efficiently as possible. A gas generator will be used when neither of those sources are useable for certain amounts of time depending on the weather.

Wind turbine design

Table 1: Advantages and disadvantages of wind and solar energy sources

Energy Source:	Advantages:	Disadvantages:
Solar	-Sunlight present in almost all the probable disaster areas -Can be integrated into the tent	-Efficiency limited by the area and the time of day
Wind	-Wind turbines can be constructed using local materials	-Efficiency dependent on the size of the turbine -Not viable for areas with low wind speeds
Gas Generator	-Provides abundant energy power. -It is not dependent on environmental conditions to work	-The high costs of gasoline makes it the least affordable option -Logistics in transportation of gasoline hinders relief efforts

Design Criteria:

- Structural Dimensions of 15ft x 15ft x 8ft
- Easily transported in a series of backpacks to be assembled on site
- Use of HEPA filters to provide sanitary air filtration
- Laminar air flow
- Power supply supplemented by solar panels and wind turbines.
- Instruction manuals for set-up and maintenance
- Training guides included to promote local involvement

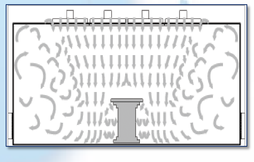
Filtration:

Triple layered material

1. Solid outer wall
2. HEPA filter
3. Perforated inner wall

- Same airflow as standard US operating rooms
- Cooling effect for patient and doctors
- Creates a curtain of clean air

LAMINAR AIR FLOW



Laminar flow downward
V = 0.15 m/s
Air coming in * (.85) = Air going out
Air must be sterilized every hour
Maintain positive pressure

Community Involvement:

- Provide training for aid organizations on use and maintenance of product to ensure full utilization of its benefits
- Improve communication between relief organizations and locals by providing Community Preparedness Plan
- Additionally train first responders on encouraging involvement of local communities post natural disaster

Impact:

By making a treatment room that can be deployed as an immediate response post natural disaster, many lives would be saved and infections prevented because they would be treated immediately and protected by a sterile environment. The idea of modularity will prevent extreme crowding of people around one area which helps minimize the spread of disease.

Future Plans:

M.O.R.E. Life plans to make these mobile operating rooms available to relief organizations for immediate care response after a natural disaster.

By making prototypes and testing them in locations where harsh and unsterile environments are encountered everyday, useful feedback from medical organizations who utilize this operating room can be considered in order to improve the product's characteristics.

M.O.R.E. Life also plans to continue exploring better portability features and the idea of modular systems to ensure easy transportation through areas that have experienced devastation.

Modularity Implementation

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